



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/904,129	07/11/2001	Tetsuzo Ueda	53074-025	1689

7590 10/27/2003
Michael E. Fogarty
MCDERMOTT, WILL & EMERY
600 13th Street, N.W.
Washington, DC 20005-3096

EXAMINER

SONG, MATTHEW J

ART UNIT PAPER NUMBER

1765

DATE MAILED: 10/27/2003

15

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/904,129

Applicant(s)

UEDA, TETSUZO

Examiner

Matthew J Song

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 July 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 16,17,19-35,37-43,48 and 51 is/are pending in the application.
- 4a) Of the above claim(s) 21,22 and 26-30 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 16,17,19,20,23-25,31-35,37-43,48 and 51 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other:

Art Unit: 1765

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 7/3/2003 has been entered.

Claim Objections

2. Claim 33 is objected to because of the following informalities: Claim 33 is dependent on a non-elected claim. Appropriate correction is required.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 16, 17 and 19 are rejected under 35 U.S.C. 102(b) as being anticipated by Puchinger et al (Gallium nitride thin layers via a liquid precursor route).

Art Unit: 1765

Puchinger et al discloses spin coating a gallium carbodiimide based precursor at 2000 rpm onto a sapphire substrate and pyrolyzing in NH_3 at 900°C (Abstract and Table 1). The gallium carbodiimide base precursor reads on applicant's liquid comprising group III element and nitrogen because it is composed of Gallium and nitrogen. The precursor is heat treated until transformation of a poly or single crystal thin film, this reads on applicant's so as to crystallize the spin coated layer (pg 154). Puchinger et al discloses the process was repeated three times to grow thicker films (pg 154), this reads on applicant's growing a III-V nitride alloy on the spin coated layer after annealing.

5. Claims 16, 17 and 19 are rejected under 35 U.S.C. 102(e) as being anticipated by Aldinger et al (US 6,254,675).

Aldinger et al teaches a precursor compound is distributed uniformly over a substrate of Si, SiC or Al_2O_3 by spin coating and a pyrolysis treatment of the precursor compound is carried out by heating to a temperature of at least 600°C , preferably 900°C under a reactive atmosphere containing ammonia to convert the precursor into crystalline GaN (col 2, ln 1-65 and Claim 1). Aldinger et al teaches a precursor compound of $\text{Ga}_w(\text{NCN})_x(\text{SiMe}_3)_y\text{Cl}_z$ (col 4, ln 1-10 and claim 3), this reads on applicant's liquid comprising group III elements and nitrogen. Aldinger et al also teaches an article comprising at least another GaN layer deposited thereon (claims 14-15).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

Art Unit: 1765

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claim 16-17, 19 and 24-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hanaoka et al (US 5,804,839) in view of Puchinger et al (Gallium nitride thin layers via a liquid precursor route) or Aldinger et al (US 6,254,675).

Hanaoka et al discloses a method of forming a III-V nitride compound semiconductor device, note entire reference, where a AlN buffer layer 42 is formed on a SiC substrate 41 by MOCVD to a thickness of 30 nm at a substrate temperature of 1050°C and on the AlN buffer layer is formed by MOCVD a n-type GaN layer 13, n-type AlGaIn layer 14, InGaIn:Zn layer 15, a p-type AlGaIn layer 16 and a p-type GaN layer 17. Hanaoka et al also discloses a p-type GaN layer 18 formed by molecular beam epitaxy (Example 2).

Hanaoka et al discloses all of the limitations of claim 16, except spreading a liquid comprising group III elements and nitrogen on a substrate and coating the substrate with a thin film comprising group III elements and nitrogen by spinning at selected rotation speeds.

In a method of forming gallium nitride, note entire reference, Puchinger et al teaches a chemical solution deposition method used to grow thin epitaxial GaN film on sapphire substrate. Puchinger et al teaches the film were grown by spin coating a gallium carbodiimide based polymeric precursor, this reads on applicant's liquid comprising group III elements and nitrogen, onto sapphire and pyrolyzing in NH₃ at 900°C (Abstract). Puchinger et al also teaches buffer layers or AlN or GaN were found to improve the crystal quality of deposited GaN films (pg 153-154). Puchinger et al also teaches the GaN films may be used as buffer layers in conventional GaN thin film growth techniques (pg 154). Puchinger et al teaches spinning speeds (table 1) and

Art Unit: 1765

heat treating until transformation of a precursor material into a poly or single crystal thin film (pg 154), this reads on applicant's annealing so as to crystallize the spin coated layer. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Hanaoka et al with Puchinger method of making a buffer layer for GaN films using solution deposition because it is simpler than conventional techniques (pg 154).

In a method of producing GaN layers, Aldinger et al teaches a precursor compound is distributed uniformly over a substrate of Si, SiC or Al₂O₃ by spin coating and a pyrolysis treatment of the precursor compound is carried out by heating to a temperature of at least 600°C under a reactive atmosphere containing ammonia to convert the precursor into crystalline GaN (col 2, ln 1-65 and Claim 1). Aldinger et al teaches a precursor compound of Ga_w(NCN)_x(SiMe₃)_yCl_z (col 4, ln 1-10), this reads on applicant's liquid comprising group III elements and nitrogen. The GaN layers can be used as buffer layers for production of thick GaN layers (col 3, ln 30-45). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Hanaoka et al with Aldinger et al's method of making a buffer layer for GaN because it is simpler and economically advantageous (col 1, ln 25-40).

Referring to claims 17, the combination of Hanaoka et al and Puchinger et al or Hanaoka et al and Aldinger et al teaches annealing in NH₃.

Referring to claim 24-25, the combination of Hanaoka et al and Puchinger et al or Hanaoka et al and Aldinger et al teaches forming layers by MOVCD and a forming a layer 18 by molecular beam epitaxy, the examiner interprets this to read on claim 25 as two methods of film deposition in sequence.

Art Unit: 1765

8. Claims 16-17, 19, and 31-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nishio et al (US 5,786,606) in view of Puchinger et al (Gallium nitride thin layers via a liquid precursor route) or Aldinger et al (US 6,254,675).

Nishio et al discloses a silicon substrate with a silicon-carbide surface layer thereon grown by MOCVD at a temperature of 600°C (col 4, ln 1-67 and Example 1) and AlGaN buffer layer, thereon by MOCVD and growing an n-type GaN layer on the buffer layer, note entire reference.

Nishio et al discloses all of the limitations of claim 16, except spreading a liquid comprising group III elements and nitrogen on a substrate and coating the substrate with a thin film comprising group III elements and nitrogen by spinning at certain rotation speeds.

In a method of forming gallium nitride, note entire reference, Puchinger et al teaches a chemical solution deposition method used to grow thin epitaxial GaN film on sapphire substrate by spin coating a liquid precursor comprising group III elements and nitrogen, onto sapphire at selected speeds and pyrolyzing in NH_3 at 900°C to crystallize the precursor, as discussed previously. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Nishio et al with Puchinger method of making a buffer layer for GaN films using solution deposition because it is simpler than conventional techniques, as taught by Puchinger et al.

In a method of producing GaN layers, Aldinger et al teaches a precursor compound is distributed uniformly over a substrate of Si, SiC or Al_2O_3 by spin coating and a pyrolysis treatment of the precursor compound of group III elements and nitrogen is carried out by heating to a temperature of at least 600°C under a reactive atmosphere containing ammonia to convert

Art Unit: 1765

the precursor into crystalline GaN, as discussed previously. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Nishio et al with Aldinger et al's method of making a buffer layer for GaN because it is simpler and economically advantageous.

9. Claims 16-17, 19 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Furushima (US 5,815,520) in view of Puchinger et al (Gallium nitride thin layers via a liquid precursor route) or Aldinger et al (US 6,254,675).

Furushima discloses a ZnO, zinc oxide, epitaxial layer on a silicon substrate 9 and forming a III-V, an InGaAlN, buffer layer 10 thereon and forming a III-V n-type cladding layer 4 on the buffer layer, where the layers are formed by MOCVD at a temperature of 1000°C, note entire reference.

Furushima discloses all of the limitations of claim 16, except spreading a liquid comprising group III elements and nitrogen on a substrate and coating the substrate with a thin film comprising group III elements and nitrogen by spinning at certain rotation speeds.

In a method of forming gallium nitride, note entire reference, Puchinger et al teaches a chemical solution deposition method used to grow thin epitaxial GaN film on sapphire substrate by spin coating a liquid precursor comprising group III elements and nitrogen, onto sapphire at selected speeds and pyrolyzing in NH₃ at 900°C to crystallize the precursor, as discussed previously. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Furushima with Puchinger's method of making a buffer layer for GaN films

Art Unit: 1765

using solution deposition because it is simpler than conventional techniques and more economical, as taught by Puchinger et al.

In a method of producing GaN layers, Aldinger et al teaches a precursor compound is distributed uniformly over a substrate of Si, SiC or Al₂O₃ by spin coating and a pyrolysis treatment of the precursor compound of group III elements and nitrogen is carried out by heating to a temperature of at least 600°C under a reactive atmosphere containing ammonia to convert the precursor into crystalline GaN, as discussed previously. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Furushima with Aldinger et al's method of making a buffer layer for GaN because it is simpler and economically advantageous.

10. Claims 16,17, 19, and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Furukawa et al (US 6,017,807) in view of Puchinger et al (Gallium nitride thin layers via a liquid precursor route) or Aldinger et al (US 6,254,675).

Furukawa et al discloses a GaN compound semiconductor made up of a plurality of p-type, n-type or I-type GaN compound semiconductors, which are formed by MOCVD or MBE on a sapphire substrate. Furukawa et al also discloses a PN junction type consisting of a buffer layer which is made of a GaN layer formed on a sapphire substrate and a laminated structure which is made up of an n-type GaN and a p-type GaN layer both being formed on the buffer layer (col 1, ln 15-35).

Art Unit: 1765

Furukawa et al discloses all of the limitations of claim 16, except spreading a liquid comprising group III elements and nitrogen on a substrate and coating the substrate with a thin film comprising group III elements and nitrogen by spinning at certain rotation speeds.

In a method of forming gallium nitride, note entire reference, Puchinger et al teaches a chemical solution deposition method used to grow thin epitaxial GaN film on sapphire substrate by spin coating a liquid precursor comprising group III elements and nitrogen, onto sapphire at selected speeds and pyrolyzing in NH_3 at 900°C to crystallize the precursor, as discussed previously. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Furukawa et al with Puchinger's method of making a buffer layer for GaN films using solution deposition because it is simpler than conventional techniques and more economical, as taught by Puchinger et al.

In a method of producing GaN layers, Aldinger et al teaches a precursor compound is distributed uniformly over a substrate of Si, SiC or Al_2O_3 by spin coating and a pyrolysis treatment of the precursor compound of group III elements and nitrogen is carried out by heating to a temperature of at least 600°C under a reactive atmosphere containing ammonia to convert the precursor into crystalline GaN, as discussed previously. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Furukawa et al with Aldinger et al's method of making a buffer layer for GaN because it is simpler and economically advantageous.

11. Claim 20 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hanaoka et al (US 5,804,839) or Furushima (US 5,815,520) or Nishio et al (US 5,786,606) in view of Puchinger et

Art Unit: 1765

al (Gallium nitride thin layers via a liquid precursor route) or Aldinger et al (US 6,254,675) as applied to claims 16-18 above, and further in view of Iaconi et al (US 6,048,790).

The combination of Hanaoka et al and Puchinger et al or the combination of Furushima and Puchinger et al or the combination of Nishio et al and Puchinger et al or the combination of Hanaoka et al and Aldinger et al or the combination of Furushima and Aldinger et al or the combination of Nishio et al and Aldinger et al teaches all of the limitation of claim 19 including a gas atmosphere of ammonia, which is a well known reducing gas (Narumi et al below), as discussed previously, except the gas atmosphere comprises radical nitrogen atoms.

In a deposition of a thin film using a reducing ambient, Iaconi et al teaches a reducing ambient of hydrogen gas, nitrogen gas or reactive nitrogen such as plasma, i.e. radical nitrogen atoms (col 5, ln 1-65). Iaconi et al also teaches a reactive nitrogen plasma may be sufficiently reducing without heating of the substrate (col 5, ln 15-30). It would have been obvious to a person of ordinary skill in the art at the time of the invention the combination of Hanaoka et al and Puchinger et al or the combination of Furushima and Puchinger et al or the combination of Nishio et al and Puchinger et al or the combination of Hanaoka et al and Aldinger et al or the combination of Furushima and Aldinger et al or the combination of Nishio et al and Aldinger et al because radical nitrogen is a known equivalent to a reducing gas and substitution of a known equivalent for the same purpose is obvious (MPEP 2144.06) and a reducing ambient can be produced without heating, which reduces operating costs.

12. Claim 34-35, 37-42, 48 and 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Furushima (US 5,815,520) in view of Ito et al (US 5,699,035).

Art Unit: 1765

Furushima discloses a ZnO epitaxial layer buffer layer 2 on a sapphire 1 or silicon 9 substrate and a InGaAlN buffer layer 3 and an n-type InGaAlN cladding layer 4 grown on the ZnO layer, where the layers are formed by MOCVD, metal organic chemical vapor deposition, to form a pn junction, note entire reference.

Furushima does not disclose spreading a liquid comprising metal elements and oxygen on a substrate and coating the substrate with a thin film by spinning at certain rotation speeds, as interpreted by the examiner.

In a method of forming a ZnO thin film, note entire reference, Ito et al teaches a conventional spin coating, where an eyedropper is used to deposit a precursor solution with excess liquid being removed through the rotation yielding a solid metal oxide layer on to a silicon substrate or sapphire substrate (col 5, ln 1-40 and col 3, ln 40-60). Ito et al also teaches a precursor solution of metal alkoxides i.e. a liquid comprising metal and oxygen (col 4, ln 20-65). Ito et al also teaches annealing a metal oxide residue in an oxygen environment at 400-1000°C (col 5, ln 45-67 and Example 4). Ito et al also teaches ZnO layer with a grain size of less than 300 nm (col 2, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Furushima vapor phase growth with Ito et al's method of forming a crystalline film using solution because solution routes to single crystal thin films are economically advantageous, note Aldinger et al (col 1, ln 25-30), Puchinger et al (pg 154) and Lange, below.

Referring to claim 35 and 38, the combination of Furushima and Ito et al teaches annealing a ZnO layer in oxygen prior to forming additional layers.

Art Unit: 1765

Referring to claim 37, the combination of Furushima and Ito et al teaches an oxygen environment. The combination of Furushima and Ito et al does not teach a H₂O gas atmosphere. It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Furushima and Ito et al by using a H₂O atmosphere because H₂O is a known equivalent to oxygen as a oxygen environment and substitution of a known equivalent for the same purpose is obvious (MPEP 2144.06)

Referring to claim 39-40, the combination of Furushima and Ito et al teaches from a zinc oxide layer on a Si or sapphire substrate.

Referring to claim 41, the combination of Furushima and Ito et al teaches forming a pn junction.

Referring to claim 42, the combination of Furushima and Ito et al teaches a MOCVD process.

Referring to claim 48, the combination of Furushima and Ito et al teaches annealing at 400-1000°C. Overlapping ranges are held to be obvious (MPEP 2144.05).

Referring to claim 51, the combination of Furushima and Ito et al teaches annealing in an oxygen environment.

13. Claim 37 is rejected under 35 U.S.C. 103(a) as being unpatentable over Furushima (US 5,815,520) in view of Ito et al (US 5,699,035) as applied to claims 34-36 above, and further in view of Hofmann et al (US 4,784,975).

The combination of Furushima and Ito et al teaches all of the limitations of claim 37, as discussed previously, except the atmosphere comprises H₂O.

In a method of annealing, note entire reference, Hofmann et al teaches annealing in an ambient that contains an oxygen containing gaseous species, where suitable oxygen containing species include oxygen and H₂O (col 3, ln 50-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Furushima and Ito et al because H₂O is a known equivalent to oxygen as an oxygen atmosphere and substitution of a known equivalent for the same purpose is obvious (MPEP 2144.06).

14. Claim 43 is rejected under 35 U.S.C. 103(a) as being unpatentable over Furushima (US 5,815,520) in view of Ito et al (US 5,699,035) as applied to claims 34-36 and 38-42 above, and further in view of Hanaoka et al (US 5,804,839).

The combination of Furushima and Ito et al teaches all of the limitations of claim 43, as discusses previously, except the alloy film is grown by a sequential combination of more than two growth methods selected from the group consisting of MOCVD, MBE and hydride phase epitaxy.

Hanaoka et al teaches a method of forming a III-V nitride compound semiconductor device, note entire reference, where a AlN buffer layer **42** is formed on a SiC substrate **41** by MOCVD to a thickness of 30 nm at a substrate temperature of 1050°C and on the AlN buffer layer is formed by MOCVD a n-type GaN layer **13**, a n-type AlGaN layer **14**, a InGaN:Zn layer **15**, a p-type AlGaN layer **16** and a p-type GaN layer **17**. Hanaoka et al also teaches a p-type GaN layer **18** formed by molecular beam epitaxy at a temperature between 150°C and 400°C (Example 2), this is interpreted to read on applicant's limitation of a sequential combination of two growth methods. Hanaoka et al also teaches a p-type GaN layer **18** formed by MOCVD at a

Art Unit: 1765

temperature between 350° and 600°C (Example 1). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Furushima and Ito et al with Hanaoka et al because MBE operates at a lower temperature, thereby reducing operating costs.

Response to Arguments

15. Applicant's arguments with respect to claims 16 and 34 have been considered but are moot in view of the new ground(s) of rejection.

The rejection of claim 34 has been changed to include a new motivation for the modification of Ito. The new motivation is that solution growths of thin film is economically advantageous over vapor phase growths, which is evidenced by Aldinger, Lange and Puchinger. Therefore, applicant's arguments alleging there is no motivation to combination Furushima with Ito is moot.

Applicant's argument that Ito et al is silent to annealing a gas atmosphere wherein the annealing is the method by which to crystallize the spin coated layer is noted but is not found persuasive. Ito et al teaches crystallizing a dried thin film zinc oxide layer (P30), where step **P30** includes annealing in an oxygen atmosphere (col 7, ln 45-67 and Abstract).

Applicant's argument that Ito et al is directed to a ZnO layer with a grain size less than 300 nm rendering it difficult to grow a III-V layer thereon is noted but is not found persuasive. This is view as mere attorney argument, which lacks evidence; therefore is not persuasive. Furthermore, Ito et al is not limited to ZnO layers with a grain size less than 300 nm, as

Art Unit: 1765

suggested by applicant. It teaches the annealing process parameters control the size of grains and producing grains of 10 nm (col 6, ln 1-15).

Conclusion

16. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Enomoto et al (US 5,227,011) teaches forming a ZnO layer by multiple equivalent methods, which include MOCVD, MBE and spin coating (col 9, ln 35-55).

Narumi et al (US 4,990,323) teaches a heat treatment performed in a current of a reducing gas such as, hydrogen, carbon monoxide or ammonia or a mixed gas consisting of a reducing gas and an inert gas such as nitrogen or argon (col 3, ln 1-40).

Keller et al (US 5,891,790) teaches a substrate for the formation of GaN is typically sapphire, but other materials such as silicon carbide, zinc oxide, silicon can be used (col 3, ln 1-10 and claim 7).

Logan et al (US 3,829,556) teaches a sapphire substrate can be used or a substrate such as silicon carbide or other substrate with lattice structures compatible with the growth of gallium nitride can be used (col 4, ln 35-55).

Lange ("Chemical solution routes to single crystal thin films") teaches one advantage solution routes is the economics relative to capital intensive vapor phase routes and a second advantage is the high degree of compositional control inherent with solution synthesis (pg 903).

Art Unit: 1765

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 703-305-2667. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS

NADINE G. NORTON
PRIMARY EXAMINER

